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INSTITUTE OF OCEANOGRAPHIC SCIENCES

DEACON LABORATORY

CRUISE REPORT NO. 231

RRS *CHALLENGER* CRUISE 79
12 MAY-03 JUN 1991

Benthic biology at the European Community Station
(48°50'N 16°30'W) and in the Porcupine Seabight

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ABSTRACT

Challenger Cruise 79 had two major objectives. The first was a detailed investigation of the abundance, biomass and size structure of the abyssal benthic community at the EEC Station covering organisms from bacteria to the megafauna. This work forms part of a longer-term study of latitudinal and temporal variations of community structure controlled by physical parameters of the overlying water column.

The second objective was to study the abundance, biomass and size structure of meiofaunal and macrofaunal communities at bathyal depths in the Porcupine Seabight in relation to the dense aggregations of the sponge *Pheronema* which occur there.

The sampling programme involved use of the SMBA multiple corer to sample bacteria and meiofauna, box corer for meiofauna and macrofauna, epibenthic sledge for macrofauna and megafauna, and otter trawl for megafauna. Photographic systems were used to monitor benthic activity, necrophage behaviour and megafaunal abundance and spatial dispersion. Traps were used to sample necrophagous amphipods on the seafloor and in the water column.

Incubations at *in situ* temperature and pressure were undertaken for foraminifer and nematode feeding studies. Samples were collected to validate methodology for qualitative stress assessment of preserved biological samples, and for biogeochemical sediment studies.

KEYWORDS
ABUNDANCE
ABYSSAL ZONE
ATLANTIC(NE)
BACTERIA
BATHYAL ZONE
BENTHOS
BIOGEOCHEMISTRY
BIOMASS
BOTTOM PHOTOGRAPHS
BOTTOM TRAWLS
BOX CORER
CHALLENGER/RRS - cruise(1991)(79)
EPIBENTHIC SLEDGE
FORAMINIFERS
HOLOTHURIANS
MACROFAUNA
MEGAFAUNA
MEIOFAUNA
MULTIPLE CORER
NECROPHAGES
OTTER TRAWL
PORCUPINE SEABIGHT
SIZE DISTRIBUTION
STRESS ANALYSIS
TRAP NETS

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Depart Barry Sunday 12 May 1991

Dock Barry Monday 3 June 1991

OBJECTIVES

1. To recover a Bathysnap deployed at c. 48°N 20°W in 1990.
2. To obtain a series of benthic samples at c. 48°50'N 16°30'W as part of IOSDL LRP4.
3. To obtain a series of benthic samples and photographs in the north-western part of the Porcupine Seabight.
4. To obtain two epibenthic sledge samples in the neighbourhood of the Isles of Scilly.

NARRATIVE

Challenger sailed from Barry at 0600 GMT on Sunday 12 May 1991 and proceeded towards the Bathysnap position at 48°N 20°W. After a two-hour stop for a wire-test of acoustic releases and the deployment of the PES fish in the morning of the 14th, the vessel continued towards the Bathysnap position, arriving at 0545/15. Bathysnap could not be located during a 2 x 2 nm search centred on the position, nor a further four hours of more or less continuous exposure to the turn-on frequency during two wire tests which were completed by 1515/15. *Challenger* now made for the main work position at 48°50'N 16°30'W, arriving at 0530/16 where a further wire test was completed by 0800.

A baited Bathysnap (Bathysnack) (station 52701#1) was deployed some 3 nm south-west of the main station position, followed by a Bathysnap (52701#2) at the centre position. The Bathysnap carried a current meter immediately above the gear and an acoustic transponder 200m above the bottom. Unfortunately, contact with the transponder was lost and it made no contribution to the cruise (see Instrumentation report).

The cruise then entered its main phase, with an attempt to establish a general work pattern in which cores would be taken during the day and the longer term towed gears would be used overnight. This pattern would inevitably be constrained by the need to deploy and recover the moored gears.

Two multiple corer casts (#3 & 4) obtained 11 and 12 excellent cores respectively and were followed by a successful box core cast (#5). After some delay due to incorrect orientation of an acoustic monitor, a coarse epibenthic sledge haul (#6) was undertaken overnight and, with minor delays caused by problems with the winch spooling gear, was completed at 0630/17. During the sledge haul the neuston net was fished (#7).

Two successful multiple corer casts (#8 & 10) and one excellent box core sample (#9) were obtained by 1700/17. However, three further attempts to box core failed to produce a sample. The first of these (#11) obtained a small core of dubious quality which was destroyed by a mishap during separation of box from corer frame. This box had been used successfully before (#5). During the two subsequent hauls (#12 & 13) the corer failed to trigger, despite the gear being landed twice on the seafloor during the second haul. The problem was later attributed to incorrect rigging of the gear (see box corer report). A coarse-mesh epibenthic sledge haul (#14) followed, during which two neuston net hauls (#15 & 16) were taken.

During the previous few hauls, problems had been experienced with the main winch spooling gear because of loose turns on the winch drum. In order to improve the situation an OTSB haul was now made to re-tension the warp, although the original intention was to clear all of the required sledge hauls before using the trawl.

Accordingly, the trawl was shot at 1700/18 some 15 nm west and north of the Bathysnap position on a course to make a nearest approach to Bathysnap of about 1 nm. The main warp was first paid out to the last turn on the winch drum (13389m) with the ship making 3.5-5 knots, and then wound back onto the drum under tension to 12100m (2.5 times the trawling depth). The ship's speed was now reduced to 2.5 kts and the trawl fished successfully from 2223/18 to 0209/19 before being landed at 0600/19. The excellent catch was dominated numerically by a number of holothurian species, but also contained a wide range of other organisms including several magnificent sea pens. The catch also contained a variety of artefacts, including the imploded remains of an aluminium float fitted to the trawl by the maker and inadvertently left attached, and a perfect ship's mug marked "Red Star Line"! While this catch was being sorted the ship returned to the coring position, arriving at about 0900/19.

A close inspection of the box corer, prompted by the previous failures, showed that the lead of the cocking wire was wrong. This was corrected for deployment #18. The corer functioned properly, but failed to retain a sample. This was attributed to a badly matching box and spade. It was concluded that each box/spade pair is a unique combination and that the two pairs supplied by RVS would have to be identified and used together. While the box corer was being re-rigged, the multiple corer was deployed (#19), obtaining 12 cores, but all of them with slightly disturbed surfaces overlain by cloudy water. A box corer haul (#20) was completed by 1845/19. A good pull-out was recorded but the surface of the resulting core was badly disturbed and the sample was used for qualitative purposes only, the upper 20cm being sieved through a 1mm mesh.

Challenger then moved some 6 nm east of the coring position to fish a coarse epibenthic sledge (#21) from east to west and with a nearest approach to Bathysnap of about 0.5 nm. The net was shot at 1950/19 and fished otter-trawl style. It showed no sign of lifting off while fishing, and all traces were present. However, no evidence of camera or odometer function was obtained. A good catch was revealed on recovery at 0500/20. Two neuston nets (#22 and 23) were fished during this haul.

Challenger then returned to the coring position and obtained a good multiple corer sample (#24). The following box core sample (#25) was slightly disturbed at the edge, but was acceptable.

A water-bottle cast (#26) with the CTD rosette sampler was made to collect water at a variety of depths between 10m below the surface and 12m above the bottom and was completed by 1805/20.

The baited Bathysnap, which was to be retrieved the next morning, had been fitted with a flashing light but no radio beacon. In order to facilitate finding it on the surface, it was intended to release it at around 0430 to reach the surface shortly before dawn. In the event, the weather was so good that this was unnecessary. Nevertheless, the time slot available did not allow the use of a towed gear overnight, and a series of core samples was obtained instead. A multiple corer cast (#27) obtained 12 good cores, while two box corer hauls produced a disturbed core used as a qualitative sample and sieved through a 1mm mesh (#28) and a slightly squint but acceptable sample (#29). After the completion of the last of these cores at 0440/21 the Bathysnack (#1) was released at 0520 and retrieved by 0650.

The near-bottom amphipod trap (DEMAR) (#30), with a nominal 18h magnesium link in addition to the release, was now deployed about 1 nm southeast of the Bathysnack.

A successful multiple corer cast (#31) was followed by a coarse epibenthic sledge haul (#32), this time with the stabilising plates removed. The sledge was deployed successfully at the second attempt and fished in the same way as #21. The catch was good, but the photographs suggested that the sledge had adopted a nose-up attitude again.

During a successful corer cast (#33), which was completed by 0420/22, the DEMAR radio signal was received at 0252 indicating that the rig was on the surface. It was located successfully by navigating on the acoustic beacon and was recovered at 0500/22.

A second Bathysnack (#34) was deployed at 0630/22 and reached the seafloor at 0830. During its descent the vessel moved about 1 nm to the southeast for a second DEMAR deployment (#35) which was launched at 0756 and reached the bottom at 0942.

Challenger then returned to the coring position for a box core (#36) and a multiple core (#37) before deploying the coarse epibenthic sledge once more (#38). As the stabilizing plates seemed to make no difference to the fishing attitude of the sledge, they were replaced. With the sledge only a few metres above the bottom, all acoustic traces were lost. The sledge was fished blind, and the traced returned during hauling. The catch was good, but photographs were of little value, mostly taken with the sledge in a nose-up attitude.

During a successful multiple corer cast (#39), a signal was received from the radio transmitter on the DEMAR rig (#35), indicating that it was on the surface. The mooring was retrieved by 0800/23 and *Challenger* then moved about a mile to the southeast to deploy the Vertical *Eurythenes* Trap (VET), a 1000m long mooring with a series of amphipod traps at intervals along it.

After returning to the coring station a good box core sample was obtained (#41), but only after the corer had been driven into the seafloor twice, having failed to trip on the first occasion.

On completion of the corer haul, *Challenger* moved some 16 nm to the northwest of the centre position to begin an otter-trawl head to wind to the southeast and passing about 1.5 nm north of the Bathysnap position. This haul (#42), was completed by 0730/24. It was even more successful than the first, producing a large catch of invertebrates dominated, as before, by *Oneirophanta*. During the trawl, two neuston nets were fished (#43 & 44).

A successful multiple corer cast (#45) was followed by an unsuccessful box corer deployment (#46); three drops onto the seafloor failed to trigger the corer. The corer arrived at the surface with the string restrainer broken and the lid doors closed. Obviously the spade had been swinging considerably in mid-water, but apparently insufficient weight had been taken off the wire to allow the release mechanism to work. When lowered very gently onto the deck the corer worked perfectly; a mystery! A repeat box corer cast (#47) worked successfully and obtained an acceptable core.

The first fine epibenthic sledge haul (#48) was fished overnight from 2000/24 to 0400/25. No evidence for odometer movement or photographs was recorded, but the catch was quite rich and very clean. When this haul was completed, *Challenger* returned to the central station position to deploy the WASP (Wide Angle Survey Photography) system. It was launched in ideal conditions and held within its photographing range for an hour prior to recovery at 1030/25. The VET mooring was released at 1130/25 and retrieved successfully by 1410. The mooring was redeployed immediately (#50) about a mile to the northwest of the previous site and was monitored until it reached the bottom at 1830/25.

A successful multiple corer cast (#51) was followed by a disastrous fine epibenthic sledge haul (#52), at least from the sorter's point of view. During the haul, acoustic traces and dynamometer reading began to oscillate suggesting that the sledge was digging in periodically. Recovery proved difficult, with large quantities of mud in all three nets. The left hand net was so badly damaged that a significant part of the sediment was lost. The catch from this net was discarded. Washing mud from the nets with hoses took two hours.

A successful multiple corer cast (#53) was followed by an unsuccessful box corer cast (#54) in which the corer failed to trigger despite three attempts to drive it into the bottom. Over the previous couple of days the easterly wind had increased gradually to about 20 kts, raising a significant swell. This may well have contributed to our failure to obtain further usable box cores at the main work site, though it is not clear why these conditions should have caused the corer to fail to trigger on so many occasions. The corer did trigger during the next cast (#55) and obtained a core, but the sample was lost during hauling because of leakage between the spade and the box.

A second WASP deployment (#56) was launched at 1800/26. Initial paying out speed was low due to surge from the swell. No evidence of operation was received from the flash detector, and on retrieval the failure was traced to faulty leads. This was followed by another fine mesh sledge haul (#57). Traces were lost during paying out because of a course alteration and the non-availability of beam steering (see Ship's systems report). Traces were recovered prior to bottom contact and a small, clean catch resulted from a short haul.

With the completion of this sledge haul at 1030/27 it was time to assess the progress to date and plan the efficient use of the remaining sampling time. The multiple corer objectives had been completed and the catches from the OTSB were so good and so consistent that further hauls were deemed unnecessary. Six good box core samples had ben obtained and a further three had been used as qualitative samples. It was therefore worth trying to improve the score, though our recent experience with the corer suggested that success was unlikely. The success of the sledge was more difficult to assess. Both coarse and fine-sledge samples were adequate, but the hauls had failed to obtain a significant number of usable photographs. While the stabilising plated had made the gear easy to deploy, its performance on the bottom seems to be extremely erratic. It was decided therefore to use the next 24 hours or so in retrieving the three outstanding moorings, one to be redeployed as a long-term Bathysnap, and in box coring and WASPing.

Accordingly, the VET (#50), Bathysnack (#34) and Bathysnap (#2) were all released and retrieved successfully by 1820/27.

A box corer cast (#58) failed to trigger despite three drops onto the bottom, the third at 1m/s! On recovery it transpired that the spade closure wire had become hooked on the top of the box pillar and the main warp had a serious kink about 1m from the termination.

A WASP deployment (#59), using colour film, appeared to work satisfactorily and was fished for three hours before recovery at 0430/28.

A final box core cast (#60) once more failed to trigger despite three bottoming attempts, but triggered readily on deck!

Finally, a long-term Bathysnap, using the camera off the Bathysnack deployment which was known to be working satisfactorily (see camera report), but without the current meter, was deployed at 0920 and reached the bottom at 1117. This completed the work at the deep station and *Challenger* sailed north for the Porcupine Seabight, arriving at the 'sponge' station at 51°39'N 13°00'W at 1200/29.

The next 68 hours were hectic. The main objectives were two-fold; first, to investigate further the dense aggregations of the sponge *Pheronema carpenteri* encountered at depths between about 1000 and 1300m during earlier Seabight studies, and second, to obtain a series of samples for meiofaunal and physiological studies over a considerable depth range. As a result of these requirements, a transect of stations was worked from 52°N 13°30'W at a depth of about 500m, to 51°34'N 12°50'W at a depth of 1500m, with the sponge work concentrated on three stations, one within the sponge population, one above at 900m and one below at 1500m. Since the corer casts at these depths took less than an hour, and certainly much less than the time required to deal with the resulting samples, the programme had to be organised with some care.

On arrival at the first station, within the sponge patch, a multiple corer cast was made (52702#1), retrieving 12 good cores with evidence of phytodetritus. This was followed by a successful box core (#2) which obtained an excellent core containing a mass of sponge spicules and a mound, presumed to be the site of a demised sponge, surrounded by ophiuroids and other associated megafauna. A three hour WASP deployment (#3) was then made, starting at the station position and moving on a southwesterly course, that is down-slope.

DEMAR (#4) was now deployed at 2000/29 with a nominal 18 hour magnesium link. Unfortunately, neither a radio beacon nor flashing light were available for this deployment, both having been used on the long-term Bathysnap deployment at the deep station. This was a mistake, as we were to realise later. This visit to the sponge station was completed by a further box corer cast which obtained a good core, but quite different from the first core at this position, containing no ophiuroids and very little evidence of sponges.

Challenger then moves some 10 nm southwest to the 1500m station, beginning with a multiple corer cast (52703#1) which again obtained 12 good cores with evidence of phytodetritus. A box corer cast (#2) failed because the spade closure wire became hooked around the shaft of the large lifting shackle. The wire was slightly stranded, but the broken strand was secured with PVC tape and the next deployment (#3) obtained a good sample. A second multiple corer cast obtained a further 12 good cores. The ship moved some 6 nm to the west for an otter trawl haul (#5) through the station on an easterly course. The trawl was inboard by 0940/30 with a large fish catch, mainly rat-tails, but with a rather disappointing invertebrate catch including large numbers of holothurians. A box corer cast (#6) produced a disturbed sample and the closure wire was again stranded, this time more seriously since one complete bundle of strands had parted.

The vessel returned to the 1250m station to recover DEMAR but, as feared, the magnesium link must have parted already since no acoustic contact could be made with the rig. A two-hour search in excellent sea conditions in the presumed down-drift direction failed to locate the rig and the attempt was abandoned at 1600/30.

A box core cast (52704#1) produced the third good core from this locality, this time including a sponge! As planned previously the opportunity was taken for a detailed analysis of the distribution of megafauna and macrofauna in the vicinity of a sponge. This involved the extensive sub-coring of the box core (see box corer report) a procedure which took several hours. In the meantime a one-hour WASP deployment in the sponge area (52704#2) was undertaken, moving downslope towards the station from a position about 1 nm to the northwest.

The original intention had been to move upslope to the 900m station, but because of the amount of work involved in dealing with the 'sponge' box core, this station was missed out and the ship moved instead up the transect to a station at a depth of 600m (52705). A multiple corer cast produced 12 good cores. These samples were to be the subject of Ann Vanreusel's meiofauna grazing experiments and required a period of about three hours during which the ship was as stable as possible for the manipulations. In fact, the weather was so good that we could have undertaken a towed gear haul, but instead a one hour WASP deployment (#2) was followed by a second multiple corer cast (#3) completed by 0200/31.

An otter-trawl haul at this station (52705#4) failed to produce sufficient suitable material for the stress assessment work so a further trawl at a depth of 500m (52706#1) was undertaken, but with similarly disappointing results. A multiple corer cast (52706#2) was obtained before the ship returned to the 900m station.

At this station between 1100/31 and 2215/31 three box corer casts (#1, 4 & 6), one multiple corer cast (#2), one otter-trawl (#5) haul and one short WASP deployment (#3) were completed.

The cut-off time for leaving the Seabight to return via the Scillies was between 0600 and 0700/1, so that time was somewhat pressing since we still required one further box core sample from the sponge station and two from the 1500m station. Therefore, the ship made for the sponge station, arriving at 2315. However, since the last box core from the 900m station was still being processed and the successful box/blade combination was not available, a one hour WASP deployment (52708#1) was made and completed by 0120/1. A successful box corer cast (52708#2) produced a good sample which, like the first one obtained at this site, contained many surface spicules.

Challenger moved to the final station in the Seabight, arriving at 0340/1. A good box corer sample (52709#1) was obtained by 0507 (the second from this site), but since it was taking almost 90 minutes to empty a filled box, there was no possibility of re-using this box/spade combination and meeting the departure deadline. The only possibility was to use the other combination, in which we had little faith from our previous experience. Surprisingly, and to the considerable relief of the Principal Scientist, the second box/spade combination produced a good core (52709#2) and *Challenger* sailed for the Scillies station at 0636/1.

Two short hauls with an antediluvian IOS epibenthic sledge were made off the Scillies during the morning of June 2 (52710#1 & 2) and the ship docked at Barry at 0830/3.

Epilogue

This was a most successful cruise. The weather was near perfect throughout and, with minor exceptions such as the failure to retrieve the 48°N 20°W Bathysnap, the curious sledge photograph results and the disappointing trawl catches in the Porcupine Seabight, all of our objectives were achieved. It is a pleasure to record our thanks to the ship's personnel for their interest and involvement in ensuring this success.

ALR

OPERATING AND MONITORING SYSTEMS

Ship's systems

Ship's deep ocean echosounder

The Simrad electronics performed well in its basic role apart from some unexplained erratic jumps at depths of about 1500 metres. However, it is not suitable for monitoring use with anything more complex than a simple bottom finding pinger.

PES fish

The towed fish was used for all monitoring work. There were two problems with it. Firstly, the transducer wiring allowed access in banks of three only which restricted the beam steering to fore and aft. This was a considerable disadvantage in the fishing of OTSB and sledges using 12000 metres of warp where the gear tows off to one side. Secondly, the short towing cable meant that the fish was only four metres below the surface when hove to and one metre at 8 knots. Not only is this very bad for the acoustic performance of the array, but in rough weather the fish leaves the water risking snapping the cable. The short cables were designed for use with the old *Discovery* towing boom only. All remaining short cables should be traded in to IOSDL for the standard version.

IOSDL systems

Equipment monitoring techniques

All the sampling systems rely on acoustic monitoring and control for successful operation. The acoustic monitoring techniques have been in use for more than twenty years. While the basic principles are still the most appropriate for the task, the current generation of equipment is no longer adequate. In particular the new deep sea echosounder (Simrad) is not suitable for this application. This is not too much of a disadvantage for simple applications using bottom approach pingers, although even here a waterfall display such as the Poseidon Technology unit, developed specially for IOSDL applications, would be a significant improvement. The implications for IOSDL are major but we will rely heavily on the PES Mk3 transducer array. No commercially available system can replace it.

For listening to the signals we made exclusive use of the amplifier and beam steering unit developed for the IOS PES Mk4 as currently fitted to the RRS *James Clark Ross*. Without this combination none of the long range systems could have been fished. The amplifier was linked to two IBM clones running in parallel and fitted with the Poseidon Technology waterfall display hardware card and software for real time monitoring and control. The RVS Waverley thermal linescan recorder was run in parallel to provide hard copy. All instruments were completely reliable throughout the cruise. Critical waterfall display pictures were logged for future reference and analysis.

Signal loss at long range has always been a problem. Without the restrictions imposed by the PES Mk3 listening system we should be able to increase pulse detectability without increasing power consumption. A combination of this together with beam steering unit ability to point to the quarters, when all elements are available from the towed array, should overcome most of the problems experienced when fishing the long range gears.

Instrument systems

Benthic sled monitoring. One acoustic monitor and set of sensors was used for all sedge runs. The odometer failed to operate on all runs despite modifications and successful deck trials. Odometers have posed long-term problems and a major redesign is called for. The flash sensor failed to register on several runs but this appeared to be due to peculiar fishing characteristics of the sledge. Considerable suitably qualified thought needs to be given to this problem. Signals were lost on several occasions when alterations were made to the ships heading to counteract bad wire angles. Beam steering at 60 degrees to the vertical was necessary on all runs.

Otter trawl monitoring. The monitor performed well to ranges of 13000 metres, although as with the sledge, signals were lost at extreme range when the ship's heading was altered. Beam steering at 60 degrees to the vertical was necessary on all runs.

Near bottom camera system (WASP). The first run failed due to a faulty underwater connector. All the others were successful. The acoustic monitor contains a timer which prevents operation for 30 minutes after switch on. This prevents operation in the top 1000 metres of the water column where the high frequency echosounder can react to concentrations of midwater organisms. This caused initial confusion at the first shallow station. The operating technique involved stabilizing the ship on the required course at about 1.5 knots. The descent was halted at about 100 metres above the seabed and the height checked using 10 kHz reflection. WASP was then lowered to 30 metres off and stopped, allowing a more accurate height to be established using the high frequency echo sounder. The winch driver was then asked to pay out a stated amount of wire bringing WASP to about 10 metres above the seabed thus turning on the camera system (operating range 7 to 18 metres). Requests for 2, 3, or 4 metres of payout or haul were then used to maintain the system in the range 7 to 11 metres. This required adjustments at between 1 and 3 minute intervals and we are extremely grateful to the winch drivers for their patient cooperation. Photographing runs varied from ten minutes to three hours as required. Deployment speed was 40 metres per minute and recovery speed 60 metres per minute.

Corer monitoring. All corer deployments were monitored using standard IOS type H 10 kHz pingers.

Moored instruments. All acoustic units were wire tested before use. The long term Bathysnap due for recovery would not respond to interrogation. An acoustic box search was carried out before the site was abandoned, but failed to locate the instrument. Another Bathysnap was laid for 11 days, recovered successfully recovered and relaid for recovery next year. Bathysnack was laid and recovered successfully twice, as was a string of midwater amphipod traps (VET). A bottom amphipod trap (DEMAR) was laid with a magnesium corrodeable link as backup to the acoustics. The first deployment returned by corrosion prior to acoustic contact and was located by signals from the radio beacon. The second deployment surfaced in the same way. Acoustic contact was made but by bottom echo which gives contact ranges to 5 kilometres in 5 kilometre water depths. The radio was then deployed on the long term Bathysnap rig (this should really have been an ARGOS beacon). On the third deployment the rig again surfaced early but could not be located in spite of a visual and acoustic search. The water depth was only 1200 metres which gives an acoustic contact range less than the visual range. Corrodeable links must not be used without a radio beacon fitted to the surface buoyancy.

Acoustic navigation. To assist a quantitative description of the benthic ecology an acoustic navigation system is required to locate sampling positions relative to each other. The major problem is navigation of long range towed nets. A simple extension of standard techniques was abandoned after ongoing instrumental problems: it was put together in a rush as an interim solution and never given the necessary trials time for debugging. An advanced commercial system was purchased prior to this cruise. When fully operational this will allow the sea units to carry out the ranging with all the benefits of their relatively quiet and predictable acoustic environment. The system was rushed forward to bring on this cruise, but software problems delayed delivery until 3 days before sailing. When assembled to the appropriate IOSDL hardware one unit was wire tested successfully and deployed on the first Bathysnap mooring but refused to operate. Eventually this was diagnosed as a further software fault by working on the second unit. Communication with the manufacturer established that the fault was not repairable at sea. It will be going to sea later this year on a chemistry cruise but the main trials should be on an instrument trials cruise in 1992.

GRJP, DW

Cameras

Wide angle survey photography (WASP)

The Benthos 372 camera functioned well apart from a data imprint change during the second or third deployments. The most likely cause was violent contact with the ship on recovery causing a momentary loss of power and resultant resetting of the clock. The normal operating height of WASP is 7-18m above the bottom, so the camera needs to be in focus within this range only. It should be focussed with a limit (marked on the lens) short of infinity. This would lower the near focal distance and increase the usable range. A setting of f3.5 focussed at 3-20m is recommended for used with Kodak TMAX 100 push processed 1.5 stops. The grain size is smaller, enhancing resolution, and contrast can be compensated for by selection of paper during printing depending on the bottom image recorded.

The Benthos camera has some limitations in handling and ease of use. The IOSDL Mk6 camera might prove to be a good replacement. Advantages of the latter include:-

light weight
light-tight case - the camera can be extracted from the pressure housing without fogging the film
inbuilt times - no need for monitor timers etc.
Marsh & Marine type connectors - much more robust and reliable
power supply - can be internal or external, 6-18v

Disadvantages of the Mk6 camera include:-

data recording - at present time/day/date can be printed on the film, but not depth

This problem is under review and can be overcome, funds permitting.

Bathysnack

A film clip test indicated that the camera was inverted during the first deployment, but no other problems were apparent. After the second deployment, damage to the camera end of the connecting cable was found. A clip test established that the camera had functioned correctly, so the damage must have occurred during recovery. A new connector and lead was fitted.

Bathysnap

The repaired camera was set at a 288 minute interval. Camera and flash function were checked in the laboratory, and output level was checked on deck prior to deployment.

Epibenthic sledge

In so far as clip tests could reveal the camera functioned without fault, and there were no apparent misfires or exposure irregularities.

NJG

Computer support

The on-board computing facilities recorded bathymetric and navigational data and produced track charts, station plots and a station list. The computing requirements were relatively low and there were no serious problems with the system.

AT

GEAR

Multiple Corer

The gear was deployed 14 times at the deep site and 7 times in the Porcupine Seabight. At both localities it performed well, returning 238 more or less perfect cores out of a maximum possible total of 252 (Tables 1 and 2). Only one deployment (52701#19) was regarded as a failure, the core surfaces having been heavily disturbed, probably because the corer was pulled off the seafloor too quickly. The otherwise consistently good performance of the multiple corer, after the problems encountered during *Discovery* Cruises

185 and 194, was attributable to the good weather conditions, sediment characteristics which favoured core retention, the new polypropylene core catcher arms fitted during cruise 185, and the thorough service carried out by the IOSDL workshop prior to the present cruise.

Porcupine Abyssal Plain

Cores from the deep site were of uniform appearance and length (typically 290-320mm). The upper 220-260mm consisted of brown mud with a 2cm thick dark brown horizon at the base, overlying sticky, cream-coloured mud which provided a firm plug and helped to retain the core. Phytodetritus was present on a few cores (particularly 52701#33, 39, 45, 51). It consisted of light brown, flocculent, easily resuspended particles which occurred either as scattered lumps or as a more or less continuous blanket a few millimetres (in one case up to 15mm) thick. Material from 52701#10 was found to contain a variety of planktonic elements including tintinnid loricae, silicoflagellate skeletons, numerous coccoliths and occasional green particles.

Cores from station 52701 were used for a variety of purposes (Table 3). Surface sediments from the first deployment was homogenized and used in an incubation experiment to examine the influence of microbial degradation of organic matter on sediment geochemistry (I. Horsfall, G. Wolff and D. Roberts). Surface sediment and overlying water from the second deployment were preserved for bacterial counts, 16s RNA analysis and biological oxygen demand determinations (J. Patching, Galway). Sediment from the third set of cores was incubated for a study of foraminiferal diets (Gooday, see below). The remaining ten complete core sets were subsampled frozen or chilled according to a more or less standard protocol.

Porcupine Seabight

In general, cores from the Porcupine Seabight were shorter than those from the deep site (Table 2). At 1250m and 1500m (Stations 52702, 52703), the sediment consisted of soft, brown sediment changing to sticky grey mud at a depth of 60-70mm. Cores collected at shallower stations (52705, 52706, 52707) were composed of fairly uniform greenish grey mud. Fine grained phytodetritus, distinctly greener than material from the Porcupine Abyssal Plain, formed layers up to about 5mm thick at the 1500m station (52703).

Cores from the Porcupine Seabight were used mainly for metazoan meiofaunal investigations (Table 4). All those collected at Stn 52705#1 (600m) were devoted to a study of bacterial grazing by nematodes (A. Vanreusel). At other stations the samples were processed as follows: Two cores were sliced into ten 1cm thick layers and one 5cm thick layer, and preserved in formalin for meiofaunal abundance; ten 1cm thick slices of a third core were frozen for nutrient determinations; one core was sliced and subsampled for bacterial counts and pigment determinations (A. Vanreusel). Some cores were chilled for sedimentological studies and others were sampled opportunistically for foraminifers (A. Gooday), or frozen for future study.

AJG

Spade box corer

The box corer is the prime sampling gear for quantitative collection of the macrofauna, and is the only means of obtaining data on the larger deep-burrowing organisms.

The gear was deployed on 30 occasions, 18 on the Porcupine Abyssal Plain (Station 52701) and 12 in the Porcupine Seabight (Stations 52702-52709). Abyssal plain sampling met with mixed success. Six good cores suitable for full analysis and three somewhat disturbed cores suitable for qualitative analysis only were obtained (Table 5). In the Seabight, 12 deployments provided 10 good cores (Table 5). Of the 11 unsuccessful deployments, four took samples and seven failed to trigger. One sample was destroyed on deck when the core-box trolley tipped over as the frame and core head were lifted off, another (from the Seabight) was too badly disturbed to use, and two washed out during recovery, apparently because of badly matching core box and spade. It is important that box and spade be matched, and that the box is correctly orientated, ie with removable panel and spade edge coincident after sampling. Failure of the corer to trigger is frustrating, particularly in deep deployments. Two different methods are available to decide whether or not the corer has taken a sample while it is at depth. The magnification facility built in to the waterfall display on the Poseidon deck unit is able to resolve the two metre extension of the gear once the spade arm has been released. In deep water at least, the pull-out strain is directly related to successful sampling. Tensions of 3.9-4.3 tonnes accompanied pull-out on deployments yielding samples, whereas failures registered less than 3 tonnes. This early indication of success of failure makes it possible to try again if the first bottom contact fails. However, there appears to be little likelihood of success if the first attempt fails.

Close inspection of the corer after the failure of 52701#13 suggested that the lead of the cocking wire was wrong. Consultation of the plans in the PS cabin confirmed this. Following realignment of the wire, eight of the nine deployments took samples. Failure of later deployments at the deep site remain largely unexplained, although in one case the spade wire had fouled on the core pillar head.

Sampling protocols for abyssal plain samples followed closely those used on *Discovery* cruise 185 in 1989 and cruise 194 in 1990. Supernatent water was siphoned off and sieved through a 40µm mesh. The core surface was photographed and described, and obvious organisms (mostly xenophyophores, foraminiferans and komoki) were removed prior to the emplacement of two subsampling core tubes. Sediment was removed layer by layer (0-1, 1-3, 3-5, 5-10, 10-15 and 15-20cm). Down to 10cm 1000, 500, 300 and 250µm sieves were used, and below that, 1000 and 500µm only. The top 20cm of damaged but usable cores were sieved at 1000µm. Subsurface features of cores were noted during layering, subsample tube removal and disposal of sub-20cm sediment. A 57mm i.d. subcore was cut into 0-1, 1-2, 2-3, 3-4, 4-5, 5-10, 10-15 and 15-20cm layers for meiofauna analysis. These samples and the sieve residues from the main core were fixed in 10% formalin. The second subcore, in a 72mm o.d. tube, was chilled for sedimentological and granulometric analysis.

Abyssal plain box core surfaces were very soft and creamy-beige to grey-beige in colour. Xenophyophores, foraminiferans and komoki were present in varying numbers on most cores. Two hexacrobylid tunicates were found on 52701#9. Most surfaces were marked by tracks and burrows of various sorts, and several had erect tubes projecting from them. Within the cores there was little evidence of structure. The colour tended to deepen and become richer often tinged orange with increasing depth down to the redox level at 25-30cm. Below this, the colour tended to be greyer and mostly uniform. Hardness increased gradually from the soft surface layers down to and through the redox layer.

Sieved residues were very small. Faunal densities in the >1mm fraction were in the range 80-130 organisms/m^2 and thus similar to those found in 1989.

Porcupine Seabight cores were subcored for meiofauna and sedimentological/granulometric studies prior to sieving the top 10cm on a 1mm mesh. Megafaunal organisms in the top 10cm and in the lower layers were picked out. Station 52704#1 took an intact *Pheronema*, and the surrounding sediment was sampled intensively with syringes to provide data on meiofaunal distributions and densities.

Seabight cores showed much greater variability, even between cores from the same station, than did the abyssal plain samples. This variability was manifest in the variation of hardness of sediment with depth, the extent of superficial and subsurface bioturbation, and the macroscopic epi- and infauna (Table 6). Several cores at 900m and 1530m were much modified by burrows of the thalassinid decapod *Calocaris macandrewi*.

MHT

Epibenthic sledge

Attempts to improve the quantitative sampling ability of the sledge were made in 1989. Netlon lining the tunnel in front of the benthic nets was replaced by stainless steel mesh of appropriate pore size; 4mm for the coarse net and 1mm for the fine net. In addition, the old multiple net system was replaced by a version carrying three fine mesh nets. Trials of the triple fine mesh net in 1989 were cut short by the loss of the sledge. During *Discovery* cruise 194 in 1990, great difficulty was experience in fishing the fine net sledge as a result of instability in midwater. Following tank tests, inclined stabilizing plates were fitted to both sledge frames in an attempt to overcome this problem.

Eight sledge hauls were undertaken at the EEC station during the cruise; five with the coarse net version and three with the fine. The hauls were successful for the most part, but some gear damage was incurred, and persistent problems with the odometer and photographic flash recording were encountered.

The first coarse net haul (52701#6) took a reasonably good catch in excellent condition but no odometer record was obtained, and very few photographs were registered on the acoustic record. Upon recovery of the sledge it transpired that although some 700 frames had passed through the camera, the supra-benthic net had become draped over both the photocell, which detects the flashes, and the lens of the camera.

Haul 52701#14 appeared to work well on first bottom contact, taking photographs but showing no evidence of movement according to the odometer. However, difficulty was experienced in keeping the sledge photographing and only about 20 flashes were registered in a bottom time of 4 hours! Moreover, during the whole of this time no odometer movement was seen. When the sledge was retrieved at 1300/18 the net was badly torn and what little catch remained was discarded. All of the film had passed through the camera. Subsequent analysis of the film revealed that the sledge had spent a number of short periods standing motionless on the seafloor, interspersed with long periods in which the photographs were either obscured by mud or were clearly taken with the sledge mouth up.

The unsatisfactory results from the last haul suggested that a change in technique was in order. Accordingly, the sledge was fished like the otter trawl: 12000 of wire were paid out at a relatively high ship's speed (3.5 kts) and then the sledge was allowed to settle to the bottom at 1.5-2.0 kts. During this haul (52701#21) the system appeared to work almost perfectly, the gear being on the bottom continuously from 2348/19 to 0217/20 with all of the relevant traces firmly in. However, no evidence of camera or odometer function was obtained. In fact, 3 photographs were taken, but all were "midwater". Since the photometer was directed forwards to receive reflected light, these were not registered on the acoustic record. The catch, on the other hand, was good, and seemed reasonable for the length of time spent by the sledge on the bottom. The conclusion was that the sledge was somehow adopting a nose-up attitude on the bottom.

A possible cause for the nose-up attitude of the sledge might be the stabilising plates. To test this, they were removed for the next deployment (#32). In order to ensure that camera operation be registered on the acoustic record the angle of the photometer was changed so that it received light direct from the flash and not via the bottom, and with the camera operation triggered by the quadrant levels and not the net horizontal switch as in earlier hauls. Without the stabilising plates the net turned over once during shooting but was righted easily and deployed successfully, again using the 'OTSB' technique, but this time paying out 11860m. As before, the traces suggested a normal operation except that the odometer failed to move and the photographic record was difficult to interpret. Shortly after reaching the bottom, photographs were recorded for abut 14 minutes and then ceased. Hauling commenced after 70 minutes on the bottom and 30 minutes later records of photographs began again and continued until lift off. The catch was good, but the photographs were almost totally underexposed, suggesting that the front of the sledge was lifting, resulting in "mid-water" photographs.

The limited information from the previous hauls suggested that the sledge was fishing quite efficiently, but that it was adopting a nose-up attitude whether or not the stabilising plates were present. For this deployment, therefore, several changes were made to the system. First the stabilising plates were replaced; second, control of the camera was returned to the horizontal switch in the monitor; third, the flash was directed more vertically so that, if the front of the sledge lifted, the flash might still illuminate the portion of the seafloor photographed; fourth, the odometer arms were lengthened by about 50mm so that the wheel would clear the supporting bracket if it were raised significantly by contact with the bottom, but would also reach the seabed if the front of the sledge was raised. The net was shot at 1820/22 but at 2144, with 11000 mwo and with the sledge only tens of metres above the bottom, all acoustic traces were lost. The sledge was fished blind. The traces reappeared during hauling, and the sledge reached the surface at 0215/23 upright and with the camera apparently working normally. The catch was good and the photographs consisted of about 30 frames, largely obscured by mud, taken with the sledge standing more or less level on the bottom, and a long series of grossly underexposed frames; again, the sledge appears to have spent much of the bottom time in a nose-up attitude.

The first fine mesh sledge deployment (#48) was made with stabilising plates. This haul seemed quite straightforward during fishing except that in a total bottom time of some 90 minutes, neither odometer movement nor photographs were recorded and the gate open trace was present for about 20 minutes only. Nevertheless, the catch was quite rich and, gratifyingly, very clean. About 130 photographs were taken with the sledge more or less horizontal, but with one of the bridles showing in the corner of each frame.

No technical alterations were made for the second deployment (#52) which was shot at 2100/25 and reached bottom at 0027/26. Shortly thereafter it appeared to be fishing normally with all traces present except that, as was becoming the norm for this cruise, no evidence of photographs or odometer movement was obtained. At about 0105 the traces began to oscillate slowly with a period of about 20 seconds. At the same time the dynamometer was showing a similar oscillation between c3 and c4 tonnes suggesting, perhaps, that the sledge was alternately digging into and leaving the sediment. Slow hauling began at 0114 and the ship's speed was reduced. The oscillations continued until about 0124 when the traces disappeared and the dynamometer settled down. Steady, but faint, traces returned at about 0130 and the ship's speed was increased again to 1.5 kts. Apparently, the sledge stopped fishing and finally lifted off at 0202. When it arrived at the surface all three nets contained large amounts of mud and the two starboard nets were tangled together by the lazy lines which had become detached from the sledge frame. The top, rear, right hand side mesh panel on the sledge frame had been buckled up and had torn out of its retraining strips, presumably as a result of pressure from accumulating sediment. After some difficulty the port net was lifted aboard with its lazy line, but snagged and tore badly in the process. The other two nets were brought aboard intact. The process of removing the bulk of the mud from the nets using hoses took almost two hours. Catches from centre and right hand nets were retained, but a significant part of that from the left hand net had been lost, so the remainder was discarded.

The third fine epibenthic sledge haul (#57) was made with the flash detector pointing towards the flash. During deployment all traces were lost with 7500 mwo when the ship's heading was changed by 20° in an attempt to straighten the wire. A 5° correction in the heading eventually brought the traces back before the gear reached the bottom. In view of the mud catch on the previous employment, hauling this time began only ten minutes after all the 'fishing' traces were in. As before, no indication of odometer movement was recorded, nor was there evidence of flash operation during the 21 minutes of fishing time. The catch was clean and very small.

The problems of odometer failure and under-recording of camera function remain largely unresolved. Film transport through the camera appears to have been normal. In some cases at least, non-registration of function by the flash sensor may have resulted from a lack of back-scatter occasioned by the nose-up attitude of the sledge. The sledge attitude would offer some explanation for the lack of odometer readings, but catches confirm good bottom contact.

Two hauls were made off the Isles of Scilly with the old single-deck composite mesh sledge (BN1.5/Q).

BJB, ALR, MHT

Otter trawl

The OTSB14 was deployed twice on the Porcupine Abyssal Plain and four times in the Seabight. In all cases the hauls were routine and good catches were obtained, albeit occasionally lacking 'target-species'. The net was fitted with 50m bridles. Fishing technique involved paying out wire to a scope of 2.5 with the ship at 4 knots, reducing speed, and maintaining 2.5 kts while the net was on the bottom.

BJB, MHT

Wide Angle Survey Photography (WASP)

WASP was used on this cruise for the first time as a purely biological tool. The system was deployed eight times, three on the abyssal plain and five in the Seabight. Some excellent photographs were obtained, particularly in the Seabight, amply demonstrating the potential value of the system for large-scale megafaunal surveys. However, in the form available on this cruise the gear was very unreliable. Faults ranged from total failure of the camera system due to faulty leads, failure of the monitoring system to record photographs even when the camera was working, intermittent failure of the data logger resulting in loss of part of all of the LEDs and unreliability of the near-bottom echo-sounder record so that even when everything else appears to be working it is not possible to put an accurate scale on the resulting photographs.

If the above problems can be solved, the results suggest that biologically useful photographs can be obtained only from within about 10m of the sediment surface. Such photographs would allow recognition and identification of most megabenthic organisms, at least down to a length of about 10cm. At this elevation, however, the 8 sec camera interval is marginally long if a continuous sequence of overlapping frames is required.

ALR

Bathysnap and Bathysnack

The Bathysnap system was used in two distinct modes, unbaited and baited (Bathysnack), for direct comparison with the results of similar deployments made at the southern study site during *Discovery* cruise 194. All deployments employed MkV cameras with Agfa XT 320 negative colour film.

An unbaited Bathysnap (52701#2) was deployed for 11 days from 16 to 27/5, with an inter-frame interval of 9 minutes and with the current data sampled every two hours. Both the current meter and photographic systems worked well.

Two baited Bathysnack deployments, each with an inter-frame interval of 4.5 minutes, but without current meters, were made concurrently with the above Bathysnap deployment. As on cruise 194, the bait was a mackerel well wrapped in muslin. The photographic record for the first of these deployments (52701#1) lasted about 112 hours and that from the second (52701#34) 61 hours. In both cases the camera worked faultlessly throughout.

A long-term Bathysnap (52701#61) was deployed without a current meter for subsequent recovery.

ALR, BB

Traps

Necrophagous amphipods were sampled using two free-fall trap systems: DEMAR (de-rated mark and recapture trap) on the sea floor and VET (vertical *Eurythenes* trap) in the bottom 1000m of the water column.

DEMAR consisted of a 1.85 x 1.25 x 0.85m frame consisting a square trap 50 x 50 x 20cm with 0.5mm mesh walls and funnels with 45mm entrances and a standard IOSDL release. The trap was set to one end of the frame and a compensating plate of the same area at the other end. The trap was ballasted with 156kg weights and supported by five 17" glass spheres, including two in a dhan buoy and one on the recovery line. A nominal 18 or 24 hour soluble Mg release was used as a back up to the normal release.

The VET rig set traps at 5, 10, 20, 50, 100, 200, 400, 600, 800 and 1000 metres above the bottom (mab). The axis of the rig was 10mm diameter braid line interspersed as appropriate with 2m strops of 8mm wire. Individual traps were cylindrical, 75cm long and 30cm diameter with a mesh funnel at each end and a single bait container. Funnel entrances were 45mm diameter. Traps were clipped across the 2m wire strops with carbine hooks on two short strops. Ballast consisted of 360kg of chain and buoyancy of eight 17" and one 13" glass spheres. The small sphere was on the recovery line and two of the 17" spheres were incorporated into a dhan buoy.

Two DEMAR and two VET deployments were made at the EEC station and a third DEMAR drop in the Seabight. The first DEMAR deployment (52701#30) was released by the nominal 18 hour Mg link somewhat less than 17 hours after first immersion and was located by radio. The second deployment (#35), this time fitted with a nominal 24 hour Mg link, was released after about 22.5 hours immersion, and it, too, was located by radio. As a result of other commitments, the third deployment in the Seabight (52602#4) had to be put out without flash or radio. Slippage in the intervening programme, including the necessity of repeating a failed box corer deployment at the 1500m station, delayed return to the DEMAR position until after the probable Mg link release time. No acoustic contact could be made, and despite a two-hour search in ideal weather conditions, the rig was not located.

Both VET deployments were successful. The need to break the rig and hang off during deployment and recovery was obviated by the clip-on traps. As a consequence, all 1000m of the rig could be put out or brought in an hour or less.

Binding shackles and splices of the rig to protect the braid line from abrasion took some time but was worth the effort. Some form of clip-on protection would save time. Descent and ascent rates in the range 0.8-1.2m/s generated sufficient torque to cause some unlaying of the 4mm trap strops. This problem should be resolved by the insertion of small swivels into the strops.

MHT

BIOLOGICAL OBSERVATIONS

Bacteria

Many samples of bottom water, sediment, and holothurian tentacles and gut contents were collected on behalf of Dr. J.W. Patching (University College Galway). Samples will be used for bacterial counts and 16s rRNA determinations, and measurements of biological oxygen demand.

IH

Pressure incubation of Foraminifera

Preliminary experiments by C.M. Turley (PML), J.C. Green (PML) and A.J. Gooday have demonstrated the feasibility of maintaining abyssal benthic foraminifers alive under laboratory simulated deep-sea temperatures and pressures (450 atm, 2°C) for at least 42 days. During the present cruise further experiments were carried out. The main aims were (1) to present the incubated foraminifers with a selection of known potential food organisms (algae), easily identifiable in the transmission electron microscope (TEM) and (2) to investigate early stages of the ingestion and digestion of food organisms by carrying out short-term, as well as long-term incubations.

For each incubation, 15ml of surficial sediments (presumed to contain living benthic foraminifers) from multiple corer samples were placed into each of two plastic bags. One bag was topped up with 20ml of core-top water (unfed incubation), the other with 20ml of mixed algal food (a cocktail of *Chlorella* sp. 1, *Chlorella* sp.2, *Dunaliella* sp., *Platymonas* sp., *Skeletonema* sp.). The bags were sealed, care being taken to eliminate trapped air, placed in a PML or IOSDL pressure vessel, and maintained at 480 atm and 2-4°C in the constant temperature laboratory. Experiments were terminated after 3 days, 7 days and 10 days, and samples fixed immediately in 5% cacodylate buffered gluteraldehyde followed by post-fixation in osmium tetroxide. An unincubated control sample from station 52701#8 was treated in the same way. Two longer term incubations were returned under pressure to PML and IOSDL. Benthic foraminifers containing protoplasm will be extracted from the fixed samples and examined by TEM.

Unfortunately, these experiments were jeopardized by the erratic behaviour of the CT laboratory. During the earlier part of the cruise the temperature rose to 10°C on several occasions. Following a gas leakage on May 29th, the temperature exceeded 15°C, resulting in a pressure rise to 560 atm in the IOSDL vessel and complete depressurization of the PML vessel. During the following night (May 30/31) the system broke down again because the evaporators iced up. The temperature in the CT laboratory was around 12-13°C for at least three hours. On this occasion, however, both vessels held their pressure. Fortunately, the 3 day, 7 day and 10 day incubation had been completed by May 29th but there is a high probability that the long-term experiment in the PML vessel has been ruined by the rise in temperature and resulting pressure loss.

I am grateful to the ship's engineers who worked hard throughout the cruise to coerce the cooling system to operate beyond its normal limit.

AJG

Large agglutinated rhizopods

Specimens noticed on the surfaces of box corer and multiple corer samples were removed carefully and preserved separately. Ten xenophyophores were recovered from the deep site (Stn 52701). Seven were *Galatheammina erecta*, a species recently described from the nearby BIOTRANS area. The genus *Occultammina* was represented by a flat network of tubes found lying on a box-core surface (52701#25). The remaining two specimens were indeterminate. In BIOTRANS samples *Galatheammina erecta* sat upright in the sediment with the presumed root system buried and the lobate part of the test exposed. At station 52701, an upright specimen of this species was observed in a box core (series 29). However, the three specimens of *G. erecta* recovered by the multiple corer were lying on their sides with the "roots" exposed. In one case (52701#24) phytodetrital lumps were entangled between the roots, while the two other specimens (both from 52701#45) were completely buried within a phytodetrital layer. Although limited, these observations raise the intriguing possibility that xenophyophores may sometimes feed on phytodetritus, either directly or by uptake of associated DOM.

The large komokiacean *Rhizammina algaeformis* occurred on many box-core surfaces. Other komokiaceans noticed were *Lana neglecta*, *Lana* sp. (forming a reticulated, upstanding lump on the sediment surface) and *Edgertonia* sp. Three large, stercomata-filled allogromiids were found in multiple corer (52701#4) and box-corer (52701#25) samples. They projected vertically above the sediment surface with the aperture directed downwards.

A large, arborescent species of *Pelosina* (probably *P. arborescens*) was the most striking foraminifer observed in Porcupine Seabight samples. It occurred at the 500m, 900m and 1250m stations (52705, 52706, 52707), several particularly fine specimens being recovered from 900m. The surface of a box-core obtained at the deepest site (station 52703#3, 1536m) was covered with lumpy structures believed to be foraminifers, possibly sediment covered masses of *Dendrophrya* tubes.

Xenophyophores were not observed in Porcupine Seabight samples.

AJG

Metazoan meiofauna

Two cores from each of seven multiple corer deployments at the deep station were taken for meiofaunal studies. The top 15cm of each core was sliced into 1cm thick layer and will be analysed for meiofaunal abundance and diversity, chlorophyll-a, bacterial abundance, nutrient concentrations, and sediment composition. Similar samples were taken from five stations on a transect at 500-1500m in the Porcupine Seabight.

All cores from a multiple corer deployment (52705#1) at 600m were used for grazing experiments. Fifty to 100µl of 3H-thymidine was injected into small subsamples of the upper two cm of sediment. The injected samples were incubated for 0, 1, 2, 3 and 4h. Subsequent analysis will be completed at the University of Gent.

AV

Macrobenthos

Porcupine Abyssal Plain

The abundance of larger macrobenthos (>1mm) in box core samples appeared to be similar to that recorded in the previous cruise to this station (*Discovery* 185) and, as expected, rather higher than that of the southern station (*Discovery* 194). The fauna was typically dominated by polychaetes. Of particular note was the recovery of two sorberacean ascideans in one of the box cores (52701#9); *in situ* only the tubercles of the oral siphon were visible in the sediment surface and both specimens proved to be firmly rooted. Epibenthic sledge samples in the 1-4mm size range were small.

Porcupine Seabight

The larger macrobenthos (>1mm) of the upper (900m) and lower (1500m) stations was abundant and dominated by polychaetes, with no immediate differences between these two stations. Cores from the 1250m station, ie within the region of dense sponge aggregations, were very variable in terms of the macrobenthos recovered. Abundances, at least, seemed to be positively correlated with the presence of sponge spicules. The cores with distinct spicule mats and the complete sponge were characterised by an obvious and abundant large macro- / small megabenthic epifauna: particularly terebellid polychaetes, solitary gelatinous ascideans and abundant ophiuroids.

BB

Megafauna

The megafauna was sampled by two otter trawl and seven epibenthic sledge deployments at the EEC Station. The otter trawl was fished four times in the Porcupine Seabight. A few megafaunal organisms, mostly echiurids and annelids, but notably an intact sponge (*Pheronema*), were found in box cores from the Seabight.

Otter trawl samples from the abyssal plain were dominated by holothurians which formed 90% or more of the invertebrate biomass. *Oneirophanta mutabilis* ranked first in terms of numbers and biomass. Other species of significance numerically and/or by weight included *Pseudostichopus* spp. *Amperima rosea, Peniagone diaphana, Psychropotes longicauda, Benthodytes sordida, Deima validum, Molpadia blakei, Mesothuria candelabri* and *Paroriza prouhoi*. Not surprisingly, this list corresponds precisely with that generated from *Discovery* cruise 185 catches taken in 1989 at the same locality. Asteroids, (*Dytaster grandis, Hyphalaster inermis, Styracaster* sp.) formed a significant part of the catch and as did several of the spectacular, single polyped pennatulids (*Umbellula monocephalus*). Actiniarians (including *Sicyonis, Actinauge*, and *Sicyopus* parasitic on *Paroriza*) and crustaceans (natantians, eryonids and *Munidopsis* spp) were present in fair numbers. Infaunal organisms were represented by echiurans and annelids. Also present, but of lesser importance, were sponges, smaller pennatulids, ceriantharians, zooanthoids, madreporarians, sipunculids, cirripedes, mysids, amphipods, pycnogonids, gastropods, bivalves, cephalopods, ophiuroids, echinoids, crinoids and tunicates. Fish biomass was dominated by *Coryphaenoides armatus*.

Four otter trawl hauls were made in the Porcupine Seabight. Station 52703#5 (1546-1572m) was dominated by the holothurian *Benthogone rosea* and the asteroid *Plutonaster bifrons*. Hauls at c. 600m and c. 500m (52705#4, 52706#1) were aimed at material of *Nephrops norvegicus*, but failed to obtain specimens. Instead quantities of the natantian *Dichelopandalus bonnieri*, the brachyuran *Geryon trispinosus* and the holothurian *Stichopus tremulus* formed the bulk of the catch. At 884-891m (52707#5) the hermit crab *Parapagurus pilosimanus* in the zoanthidean *Epizoanthus paguriphilus* and the echinoid *Phormosoma placenta* dominated catches. The anemone *Phelliactis hertwigi* and the asteroid *Brisingella coronata* were moderately abundant. Pennatulids (*Umbellula, Kophoblemnon*) natantian decapods, hermit crabs (*Pagurus carneus*), gastropods (*Troschelia, Aporrhais*), asteroids and holothurians were of lesser significance.

MHT

Necrophagous amphipods

Amphipods are the most abundant group which is attracted to bait in the deep sea. Although the group as a whole is highly diverse, the suite of necrophagous species is small. Two benthic traps (DEMAR) and two water column trap string (VET) deployments were achieved at the EEC Station.

Only a very cursory examination of the DEMAR catches has been possible. The two deployments (#30, #35) were on the sea floor for about 16 and 19 hours respectively, and took about 1000 specimens each. The genus *Orchomene* (s.l.), represented by at least two and probably three species, was numerically dominant. This was followed by *Paralicella* (2 species) and *Eurythenes gryllus*. It is probable that at least two other species were present in small numbers. In terms of biomass, *Orchomene* and *Eurythenes* were co-dominant, together comprising more than 90% of the whole catch.

The two VET deployments (#40, #50) were on the bottom for 47 and 44 hours and took 123 and 136 specimens respectively of *E. gryllus*. Numbers of individuals per trap were highest at 5-10 mab and lowest at 50-200 mab. Mean individual size was positively correlated with distance off the bottom.

MHT

Holothurian studies

To further the studies on resource partitioning and trace metal inclusions in megabenthic organisms led by Dr. D. Roberts (Queen's University Belfast) additional material was collected. Body wall and tentacle tissue, and gut contents were obtained from a variety of holothurians (*Oneirophanta mutabilis*, n=21; *Pseudostichopus villosus*, n=6; *Psychropotes longicauda*, n=3; *Paroriza prouhoi*, n=3; *Benthogone rosea*, n=8) in addition to sediment from a multiple corer deployment.

Gross metal analysis will be carried out on body wall and gut contents and on sediment from the multiple corer. X-ray microanalysis will be used to locate metal inclusions and electron microscopy to detect sub-cuticular bacteria in the tentacles and body wall sub-samples. Gut content sub-samples were fixed for dietary analysis.

HM

Ornithology

In all 118 routine 10-minute watches were made during the cruise together with over 60 casual observations. Weather during the cruise was cooler and cloudier than average, and dominated by high pressure systems. Winds were light, reaching Beaufort 5 on four days only. The high pressure system resulted in prolonged periods of light, mainly easterly winds.

The cruise fell into five sections.

a) Passage, Barry to EEC Station (48°50'N 16°30'W); 12-15 May, 20 watches. Kittiwakes (*Rissa tridactyla*) outnumbered fulmars (*Fulmarus glacialis*) and gannets (*Sula bassana*) over shelf waters, but were replaced by fulmars and a few gannets beyond the shelf break.

b) EEC Station, 16-28 May, 72 watches. Although at least 12 species of seabird were seen, the occurrence of most was spasmodic, and numbers were very low, rarely exceeding three of any one species. During 37 watches (51%) no seabirds were seen, and the most frequently seen species, the fulmar, occurred during 19 watches only (26%).

c) Passage, EEC Station to Porcupine Seabight (c. 51°40'N 13°00'W); 28-29 May, 6 watches. Six species were seen. Numbers were low but appeared to increase a little on entering the Seabight. At least ten species were recorded with fulmar, gannet and kittiwake present during 65% of the watches. Numbers were an order of magnitude higher than at the EEC Station, with maxima of 50 fulmars and 25 gannets in a 10-minute period.

e) Passage, Porcupine Seabight to Barry; 1-2 June, 6 watches. Five species were seen, with gannets and fulmars dominating low counts until watches were terminated just north of the Isles of Scilly.

Only 13 species of seabird were identified throughout the cruise. This low species count may be attributable in part to the timing of the cruise - most migrant seabirds would have passed through the area prior to our arrival. Light winds associated with the high pressure systems may have resulted in birds moving out of the area.

During the period 21-31 May, winds were almost entirely from the NE-SE quadrant. Probably as a result of this, migrant land and shore birds were present on the ship throughout this period. Twelve species were recorded with hirundines the most frequent. Some species such as turnstone (*Arenaria interpres*) and greenshank (*Tringa nebularia*) might well have survived, but passerine species would have stood little or no chance of reaching land, a fate supported by occasional corpses found around the ship.

MHT

Stress assessment

Samples of holothurian and crustacean tissue were obtained from the Porcupine Abyssal Plain station (52701). These samples will provide the validation required for the quantitative stress assessment of preserved material. Chance observation at this station has prompted an investigation of the presumed ionic regulation which produces buoyancy in the caudal 'sail' of the holothurian *Psychropotes longicauda*; samples of body fluids and tissues have been taken for further study.

It was not possible to obtain either *Nephrops norvegicus* or *Nephropsis atlantica* from the Porcupine Seabight stations (52702-7) in order to further the current study of the relationship between stress indices and bathymetric zonation. However, frozen samples of crustacean material were obtained with a view to widening the potential of the stress assessment module of the MAST I proposal.

LEH

Biogeochemistry

Extensive sampling was undertaken at the EEC Station for members of the team headed by Dr. G. Wolff (University of Liverpool). Material from a multiple-corer drop (52701#3) and the gut contents of 18 *Oneirophanta mutabilis* were incubated at *in situ* pressure for subsequent analysis of selected organic compounds. Small samples were separated for bacterial counts. The pressure vessels worked very well, but temperature fluctuations in the constant temperature room resulted in untoward pressure variations during the incubations. Several multiple corer samples and the gut contents of 45 holothurians of eight species were frozen for future organic analysis.

IH

Photography

Photography was employed on this cruise in three distinct modes, and with very variable results.

Bathysnack/Bathysnap

The results from all three deployments completed during the cruise were excellent. During the Bathysnap deployment (52701#2) the near-bed current flowed fairly consistently in a northerly or north-westerly direction, with a strong tidal component in the speed which reached a maximum of 8-10cm/s. The photographs revealed the presence of quite abundant phytodetritus which was wafted back and forth by the currents, but which was present consistently in depressions and around mounds. For two days at the beginning of the record an echiuran worm, with a proboscis about 25cm long, showed feeding excursions which apparently are not related to the tidal currents. The only other evidence of megabenthos activity was the movement through the frames of cylindrical white objects 20-30mm long and 2-3mm in diameter. These are yet to be identified, but were also the most abundant objects seen on the sledge photographs.

The Bathysnack photographs were dominated by rat-tails, but the zoarcid *Pachycara buliceps* and the synaphobranchid *Histiobranchus bathbius* were also attracted. These results contrasted strongly with those from the southern site in which fishes were photographed relatively rarely, the main necrophages attracted, apart from amphipods, being the decapod *Plesiopenaeus*.

WASP

As intimated in the WASP gear report, the results were very disappointing. Only about 100 reasonable photographs were obtained from the abyssal deployments, but even these were of limited value, partly because many were taken with the gear too far off the bottom and, in any case, no reliable scale can be applied to them. The Seabight results are more useful since our previous familiarity with the megafauna, and particularly with the sponge *Pheronema carpenteri*, will allow approximate scales to be applied to them. Nevertheless, the absence of an accurate scale reduces their value considerably.

Benthic sledge photographs

These results were also rather disappointing. The inconsistency of the camera function records during the sledge hauls and the unsuccessful attempts to overcome the supposed problems have been alluded to in the narrative and in the sledge report. The net result was that two of the eight sledge deployments failed to obtain any usable photographs, while the other six hauls each produced between 4 and 121 usable photographs giving a total of only 267. While these photographs confirm the widespread distribution of phytodetritus and the abundance of the unidentified cylindrical objects also recorded on the Bathysnap records, the total area covered is probably too small to provide robust quantitative data for most of the megafauna.

ALR

TABLE 1

Multiple corer deployments on the Porcupine Abyssal Plain (Station 52701)

Deployment	Usable cores retained	Length (mm)	Remarks
1	11	300-310	Used for microbial degradation experiments
2	12	310-350	Used for microbiological studies
3	12	300-310	Used for foraminiferal incubations
4	12	320-335	Phytodetritus in depression
5	-	298-324	12 cores with very disturbed surfaces
6	12	306-327	
7	12	297-330	
8	12	287-312	
9	12	289-320	Several cores with thin phytodetrital layer
10	12	305-360	
11	11	317-340	Several cores with slightly cloudy water
12	12	277-310	Thick layers of phytodetritus on 2 cores, smaller amounts on others
13	12	305-335	5mm layer of phytodetritus on one core, smaller amounts on others
14	12	310-325	

TABLE 2.

Multiple corer deployments in the Porcupine Seabight
(Stations 52702-52707)

Deployment	Station	Depth (m)	Usable cores retained	Length (mm)	Remarks
15	52702#1	1244	12	140-220	
16	52703#1	1536	12	210-235	Variable amounts of phytodetritus
17	52703#4	1536	12	210-235	Varibale amounts of phytodetritus
18	52705#1	601	12	260-270	Used for nematode grazing experiments
19	52705#3	606	12	265-315	
20	52706#2	532	12	265-300	
21	52707#2	900	12	100-184	

TABLE 3

Fate of multiple corer samples from the Porcupine Abyssal Plain (52701)

Series no.	A	B	C	D	E	F	G	H	I	J
3	12	-	-	-	-	-	-	-	-	-
4	-	11	-	-	-	-	-	-	1	-
8	-	-	12	-	-	-	-	-	-	-
10	-	-	-	2	2	2	2	1	2	1
19	-	-	-	-	1	-	-	-	-	-
24	-	-	-	3	2	2	2	-	2	1
27	-	-	-	3	2	2	2	-	2	1
31	-	-	-	2	2	2	-	-	2	-
33	-	-	-	3	2	2	2	-	2	1
37	-	-	-	2	2	2	2	-	2	1
39	-	-	-	4	2	2	-	-	2	1
45	-	-	-	3	2	2	2	-	2	1
51	-	-	-	3	2	2	2	-	2	1
53	-	-	-	1	2	2	-	-	1	1

A Microbial incubation
B Microbiology
C Foraminiferan diet incubation
D Foraminiferan and nematode abundance, 0-1cm (A. Gooday)
E Foraminiferan and nematode abundance, 0-15cm in 1cm slices (A. Gooday)
F Foraminiferan and nematode abundance, syringe subsamples (A. Gooday)
G Metazoan meiofaunal abundance and diversity (A. Vanreusel)
H Light and scanning electron microscope study (H. Moore)
I Frozen
J Chilled for sediment analysis

TABLE 4

Fate of multiple corer samples from the Porcupine Seabight

Station	Depth (m)	A whole core	B 0-15cm	C 0-10cm	D 0-10cm	E whole core	F 0-1cm	G whole core
52702#1	1244	-	2	1	1	2	3	1
52703#1	1536	-	2	1	1	2	1	2
52703#4	1536	-	-	-	-	-	10[a]	-
52705#1	601	12	-	-	-	-	-	-
52705#3	606	-	2	1	1	1	-	-
52706#2	532	-	2	2	-	-	1[b]	-
52707#2	900	-	2	1	1	-	1[b]	-

A Nematode grazing
B Meiofaunal abundance and diversity
C Nutrient determinations
D Bacteria/pigments
E Sedimentology
F Foraminifera
G Frozen

[a] 10-15cm
[b] 0-5cm

TABLE 5.

Spade box corer deployments on the Porcupine Abyssal Plain (Station 52701)

Series pull-out (tonnes)	Maximum penetration (cm)	Maximum depth (cm)	Redox sieving protocol	Full	Remarks
5	-	51	29	+	
9	-	50	26	+	
11	-	-	-	-	Core destroyed on deck
12	-	-	-	-	Failed to trigger
13	-	-	-	-	Failed to trigger
18	-	-	-	-	Core washed out
20	4.1	-	-	-	Sieved to 1mm only
25	-	49	30	+	
28	4.3	-	30	-	Sieved to 1mm only
29	3.9	45.5	27	+	
36	-	-	-	-	Sieved to 1mm only
41	4.2	49.5	29	+	
46	-	-	-	-	Failed to trigger
47	4.2	49	26	+	
54	-	-	-	-	Failed to trigger
55	-	-	-	-	Core washed out
58	-	-	-	-	Failed to trigger: spade wire snagged on box pillar
60	2.8	-	-	-	Failed to trigger

TABLE 6

Spade box corer deployments in the Porcupine Seabight ordered by depth

Station		Depth (m)	Maximum pull-out (tonnes)	Maximum penetration (cm)	Redox depth (cm)	Remarks
52707	#6	900	-	25.5	8	Echiurid
	#1	905	1.2	25	7	Foraminiferans, echiurid, pectinariid and other annelids
	#4	905	-	28.5	8	Foraminiferans, dominated by *Calocaris* mound and burrows
52704	#1	1236	1.5	-	15-20	Foraminiferans, live *Pheronema*
52702	#2	1238	-	31.5	16	Sponge spicules, sipunculid, annelids, c30 ophiuroids
	#5	1239	-	31.5	?	? old *Calocaris* mound and burrow
52708	#2	1241	2.35	35	?	Foraminiferans, annelids
52709	#2	1534	2.67	38.5	?	Echiurid, annelids, occupied *Calocaris* mound and burrow
52703	#2	1534	-	-	-	No core; spade wire fouled on shackle
	#3	1536	3.0	37	17	Abundant *Dendrophyra* sp. (foraminifer)
	#6	1537	3.5	-	-	Core body disturbed, discarded: spade wire stranded
52709#1		1539	1.95	41.5	20	Foraminiferans, old *Calocaris* burrow

STATION LIST

Abbreviations used in station list

BN1.5/C	Epibenthic sledge, coarse mesh (4.5mm)
BN1.5/Q	Epibenthic sledge, single deck, combination mesh net (4.5, 1.0mm)
BN1.5/3F	Epibenthic sledge, triple fine mesh (1.0mm)
BOX CORER	Spade box corer 0.25m^2
BSNACK	Bathysnack, baited time-lapse camera
BSNAP	Bathysnap, free-fall time-lapse camera
DEMAR	Amphipod trap, benthic
MLT CORER	Multiple corer, SMBA pattern
MS	Multi-sampler, water bottle rosette
NN	Neuston net
OTSB14	Otter trawl, semi-balloon
SBN0.5	Suprabenthic net on epibenthic sledge
VET	Amphipod trap string, water column
WASP	Wide angle survey photography

Note: All depths on Station List are corrected

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 # 1	16/ 5 21/ 5	48 48.2N	16 24.9W	BSNACK	4840-4840	1045-0528 Day	Descent 0.78 m/s, ascent 1.19 m/s	4840
52701 # 2	16/ 5 27/ 5	48 50.1N	16 29.9W	BSNAP	4839-4839	1354-1620 Day	Descent 0.96 m/s, ascent 0.94 m/s	4839
52701 # 3	16/ 5	48 51.1N	16 30.0W	MLT.CORER	4843-4843	1421- Day	11 out of 12 cores	4843
52701 # 4	16/ 5	48 51.0N	16 30.2W	MLT.CORER	4840-4840	1734- Day	12 good cores	4840
52701 # 5	16/ 5	48 51.0N	16 30.1W	BOX CORER	4840-4840	2032- Day	Good core	4840
52701 # 6	17/ 5	48 50.7N 48 50.7N	16 31.8W 16 29.1W	BN1.5/C SBN0.5	4843-4844	0303-0420 Night	No odometer Tow dist. 3.291 km.	4844
52701 # 7	17/ 5	48 50.9N 48 50.9N	16 24.2W 16 23.6W	NN	0- 0	0425-0440 Dawn		
52701 # 8	17/ 5	48 51.4N	16 30.0W	MLT.CORER	4840-4840	0849- Day	12 good cores	4840
52701 # 9	17/ 5	48 51.6N	16 29.4W	BOX CORER	4842-4842	1225- Day	Good core	4842
52701 #10	17/ 5	48 51.1N	16 28.7W	MLT.CORER	4843-4843	1540- Day	12 good cores	4843
52701 #11	17/ 5	48 50.4N	16 28.8W	BOX CORER	4844-4844	1915- Night	No core	4844

STN.	DATE 1991	POSITION LAT.	LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 #12	17/ 5	48 50.7N	16 31.2W	BOX CORER	4843-4843	2238- Night	Failed to trigger	4843
52701 #13	18/ 5	48 50.4N	16 29.5W	BOX CORER	4843-4843	0154- Night	Failed to trigger	4843
52701 #14	18/ 5	48 51.5N 48 47.4N	16 29.1W 16 33.5W	BN1.5/C SBN0.5	4843-4846	0654-1053 Day	Net torn: no catch Tow dist. 9.318 km.	4845
52701 #15	18/ 5	48 44.8N 48 44.6N	16 37.3W 16 37.9W	NN	0- 0	1152-1207 Day		
52701 #16	18/ 5	48 44.6N 48 44.1N	16 38.1W 16 39.5W	NN	0- 0	1211-1241 Day		
52701 #17	18/ 5 19/ 5	48 51.3N 48 47.0N	16 30.3W 16 43.1W	OTSB14	4842-4845	2223-0209 Night	Tow dist. 17.666 km.	4844
52701 #18	19/ 5	48 51.1N	16 30.6W	BOX CORER	4843-4843	1014- Day	No core	4843
52701 #19	19/ 5	48 51.1N	16 29.7W	MLT.CORER	4843-4843	1353- Day	12 poor cores	4843
52701 #20	19/ 5	48 50.6N	16 29.7W	BOX CORER	4848-4848	1719- Day	Disturbed core: sieved to 1 mm only	4848
52701 #21	19/ 5 20/ 5	48 50.7N 48 50.7N	16 32.4W 16 42.5W	BN1.5/C SBN0.5	4842-4846	2348-0217 Night	No photos no odo Tow dist. 12.384 km.	4844
52701 #22	20/ 5	48 51.3N 48 51.4N	16 52.4W 16 53.2W	NN	0- 0	0308-0323 Night		

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 #23	20/ 5	48 51.4N 48 51.4N	16 53.3W 16 54.0W	NN	0- 0	0326-0341 Night		
52701 #24	20/ 5	48 50.9N	16 29.2W	MLT.CORER	4845-4845	0843- Day	12 good cores	4845
52701 #25	20/ 5	48 50.4N	16 29.6W	BOX CORER	4844-4844	1203- Day	Moderate core	4844
52701 #26	20/ 5	48 50.6N 48 51.0N	16 29.9W 16 29.5W	MS	10-4830	1603-1759 Day	10, 150, 1000, 2000, 3500, 4830 M	4842
52701 #27	20/ 5	48 51.1N	16 29.2W	MLT.CORER	4847-4847	1959- Day	12 good cores	4847
52701 #28	20/ 5	48 51.0N	16 29.0W	BOX CORER	4845-4845	2315- Night	Disturbed core: sieved to 1 mm only	4845
52701 #29	21/ 5	48 50.5N	16 29.5W	BOX CORER	4838-4838	0313- Night	Good core	4838
52701 #30	21/ 5 22/ 5	48 47.1N	16 25.6W	DEMAR	4844-4844	0951-0131 Day	Descent 0.97m/s: Mg link went 16H40M	4844
52701 #31	21/ 5	48 50.9N	16 30.6W	MLT.CORER	4844-4844	1210- Day	12 good cores	4844
52701 #32	21/ 5	48 48.1N 48 45.6N	16 32.0W 16 40.9W	BN1.5/C SBN0.5	4839-4843	1850-2122 Day	Tow dist. 11.793 km.	4841
52701 #33	22/ 5	48 51.4N	16 30.4W	MLT.CORER	4845-4845	0250- Night	12 good cores	4845

STN.	DATE 1991	POSITION LAT.	LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 #34	22/ 5 27/ 5	48 47.1N	16 25.6W	BSNACK	4844-4844	0830-1430 Day	Descent 0.76 m/s; ascent 1.19 m/s	4844
52701 #35	22/ 5 23/ 5	48 48.5N	16 23.6W	DEMAR	4843-4843	0942-0603 Day	Descent 0.94 m/s; Mg release	4843
52701 #36	22/ 5	48 51.3N	16 29.7W	BOX CORER	4842-4842	1152- Day	Sieved to 1 mm only	4842
52701 #37	22/ 5	48 51.5N	16 29.4W	MLT.CORER	4845-4845	1541- Day	12 good cores	4845
52701 #38	22/ 5 23/ 5	48 50.9N 48 49.4N	16 30.1W 16 24.2W	BN1.5/C SBN0.5	4844-4846	2150-0007 Night	Traces lost, bottom times estimated Tow dist. 7.734 km.	4845
52701 #39	23/ 5	48 50.6N	16 30.1W	MLT.CORER	4843-4843	0508- Dawn	12 good cores	4843
52701 #40	23/ 5 25/ 5	48 47.1N	16 23.0W	VET	4845-4845	1212-1130 Day	Descent 1.19 m/s; ascent 1.06 m/s	4845
52701 #41	23/ 5	48 51.1N	16 29.5W	BOX CORER	4844-4844	1452- Day	Good core	4844
52701 #42	24/ 5	48 52.7N 48 51.2N	16 38.5W 16 28.5W	OTSB14	4843-4845	0105-0355 Night	Tow dist. 12.559 km.	4844
52701 #43	24/ 5	48 51.5N 48 51.3N	16 30.4W 16 29.8W	NN	0- 0	0050-0105 Night		
52701 #44	24/ 5	48 51.3N 48 51.3N	16 29.6W 16 29.0W	NN	0- 0	0108-0123 Night		

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 #45	24/ 5	48 51.0N	16 30.5W	MLT.CORER	4845-4845	1025- Day	12 good cores	4845
52701 #46	24/ 5	48 51.0N	16 29.6W	BOX CORER	4845-4845	1356- Day	No core. No trigger in three tries	4845
52701 #47	24/ 5	48 50.6N	16 29.9W	BOX CORER	4841-4841	1732- Day	Good core. Pull out 4.2 tons	4841
52701 #48	25/ 5	48 51.7N 48 51.3N	16 33.4W 16 31.5W	BN1.5/3F	4846-4846	0000-0032 Night	Tow dist. 2.462 km.	4846
52701 #49	25/ 5	48 51.0N 48 51.3N	16 27.5W 16 26.7W	WASP	4842-4842	0811-0911 Day	113 photographs	4842
52701 #50	25/ 5 27/ 5	48 49.5N	16 22.8W	VET	4843-4843	1620-1130 Day	Traps 5-1000mab. D 1.10m/s,A 0.82m/s	4843
52701 #51	25/ 5	48 50.9N	16 29.9W	MLT.CORER	4843-4843	1823- Day	12 good cores	4843
52701 #52	26/ 5	48 50.4N 48 51.9N	16 31.4W 16 27.4W	BN1.5/3F	4843-4847	0027-0149 Night	c 0.65m3 of mud. LHS catch discarded Tow dist. 5.668 km.	4845
52701 #53	26/ 5	48 50.3N	16 29.7W	MLT.CORER	4843-4843	0914- Day	12 good cores	4843
52701 #54	26/ 5	48 51.4N	16 29.7W	BOX CORER	4843-4843	1235- Day	No core, no trigger in four tries	4843
52701 #55	26/ 5	48 51.5N	16 29.5W	BOX CORER	4843-4843	1607- Day	No core	4843

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52701 #56	26/ 5	48 51.6N 48 51.9N	16 29.2W 16 27.8W	WASP	4842-4842	2024-2226 Dusk	Camera failed	4842
52701 #57	27/ 5	48 51.8N 48 51.8N	16 25.5W 16 24.5W	BN1.5/3F	4842-4845	0728-0747 Day	Tow dist. 1.234 km.	4844
52701 #58	27/ 5	48 51.3N	16 29.5W	BOX CORER	4842-4842	2009- Day	No core, no trigger in three tries	4842
52701 #59	28/ 5	48 51.7N 48 52.4N	16 26.2W 16 23.8W	WASP	4844-4844	0007-0307 Day		4844
52701 #60	28/ 5	48 50.7N	16 29.9W	BOX CORER	4844-4844	0654- Night	No core, failed to trigger twice	4844
52701 #61	28/ 5	48 51.4N	16 29.2W	BSNAP	4842-4842	1117- Day	Descent 0.68m/s, for future recovery	4842
52702 # 1	29/ 5	51 39.4N	12 59.3W	MLT.CORER	1244-1244	1238- Day	12 good cores	1244
52702 # 2	29/ 5	51 39.6N	12 59.5W	BOX CORER	1238-1238	1429- Day	Good core	1238
52702 # 3	29/ 5	51 39.0N 51 37.8N	13 0.0W 12 58.0W	WASP	1245-1327	1619-1918 Day		1286
52702 # 4	29/ 5	51 39.0N	12 60.0W	DEMAR	1245-1245	2052- Night	Descent 1.20 m/s, rig not relocated	1245
52702 # 5	29/ 5	51 39.1N	13 0.3W	BOX CORER	1239-1239	2124- Night	Good Core	1239

STN.	DATE 1991	POSITION LAT.	LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52703 # 1	29/ 5	51 34.6N	12 51.7W	MLT.CORER	1536-1536	2304- Night	12 good cores. Fluff present	1536
52703 # 2	30/ 5	51 33.8N	12 49.8W	BOX CORER	1534-1534	0137- Night	No sample; spade wire fouled	1534
52703 # 3	30/ 5	51 33.7N	12 49.7W	BOX CORER	1536-1536	0309- Night	Good core	1536
52703 # 4	30/ 5	51 33.6N	12 49.8W	MLT.CORER	1536-1536	0436- Dawn	12 good cores	1536
52703 # 5	30/ 5	51 33.3N 51 33.0N	12 48.2W 12 45.6W	OTSB14	1546-1572	0752-0827 Day	Tow dist. 3.041 km.	1559
52703 # 6	30/ 5	51 33.6N	12 49.8W	BOX CORER	1537-1537	1140- Day	Core rejected	1537
52704 # 1	30/ 5	51 39.4N	12 59.9W	BOX CORER	1236-1236	1642- Day	Good core incl. PHERONEMA	1236
52704 # 2	30/ 5	51 40.1N 51 39.5N	13 1.3W 13 0.6W	WASP	1202-1220	1810-1910 Day		1211
52705 # 1	30/ 5	51 55.2N	13 28.2W	MLT.CORER	601- 601	2243- Night	12 good cores	601
52705 # 2	30/ 5 31/ 5	51 55.1N 51 55.5N	13 27.8W 13 27.5W	WASP	603- 606	2347-0040 Night		605
52705 # 3	31/ 5	51 55.0N	13 27.9W	MLT.CORER	606- 606	0137- Night	12 good cores	606

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52705 # 4	31/ 5	51 53.8N 51 54.6N	13 30.3W 13 29.1W	OTSB14	585- 590	0423-0447 Dawn	Tow dist. 2.009 km.	588
52706 # 1	31/ 5	52 0.0N 52 1.5N	13 31.4W 13 29.6W	OTSB14	515- 525	0711-0804 Day	Tow dist. 3.491 km.	520
52706 # 2	31/ 5	52 2.4N	13 27.9W	MLT.CORER	532- 532	0922- Day	12 good shortish cores	532
52707 # 1	31/ 5	51 46.8N	13 13.4W	BOX CORER	905- 905	1155- Day	Good core	905
52707 # 2	31/ 5	51 47.2N	13 12.9W	MLT.CORER	900- 900	1306- Day	12 good cores	900
52707 # 3	31/ 5	51 46.8N 51 46.5N	13 14.3W 13 14.7W	WASP	896- 896	1419-1445 Day	No flash indication at start	896
52707 # 4	31/ 5	51 47.3N	13 13.8W	BOX CORER	905- 905	1706- Day	Good core dominated by large mound	905
52707 # 5	31/ 5	51 46.2N 51 47.3N	13 15.3W 13 14.0W	OTSB14	884- 891	1917-1951 Day	Tow dist. 2.443 km.	888
52707 # 6	31/ 5	51 46.6N	13 13.6W	BOX CORER	900- 900	2155- Night	Good but shallow core	900
52708 # 1	1/ 6	51 40.1N 51 39.8N	13 2.7W 13 2.2W	WASP	1181-1199	0005-0100 Night	Calculated distance run 1 km	1190
52708 # 2	1/ 6	51 39.0N	13 0.6W	BOX CORER	1241-1241	0209- Night	Good core	1241

STN.	DATE 1991	POSITION LAT.	POSITION LONG.	GEAR	DEPTH (M)	TIMES GMT	COMMENT	MEAN SOUND. (M)
52709 # 1	1/ 6	51 33.4N	12 50.1W	BOX CORER	1539-1539	0435- Dawn	Good core	1539
52709 # 2	1/ 6	51 33.7N	12 49.9W	BOX CORER	1534-1534	0554- Day	Good core	1534
52710 # 1	2/ 6	50 5.1N 50 4.8N	6 20.0W 6 19.3W	BN1.5/Q	75- 75	0824-0835 Day	Calculated distance run 1 km	75
52710 # 2	2/ 6	50 5.4N 50 5.6N	6 16.6W 6 15.4W	BN1.5/Q	77- 77	0914-0944 Day	Calculated distance run 1.5 km	77

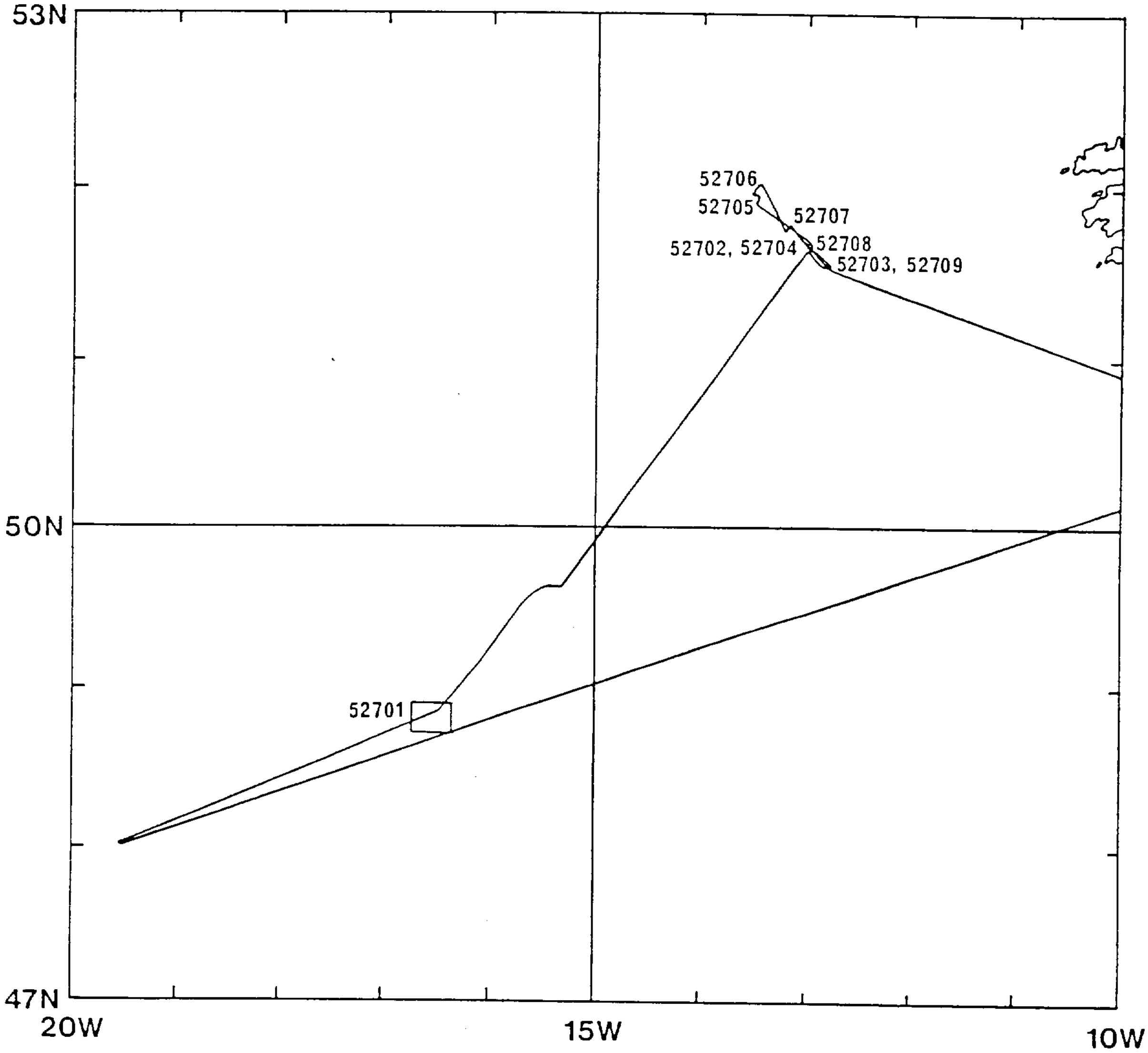

Figure 1. Track chart of *Challenger* cruise 79 12 May - 03 Jun 1991.

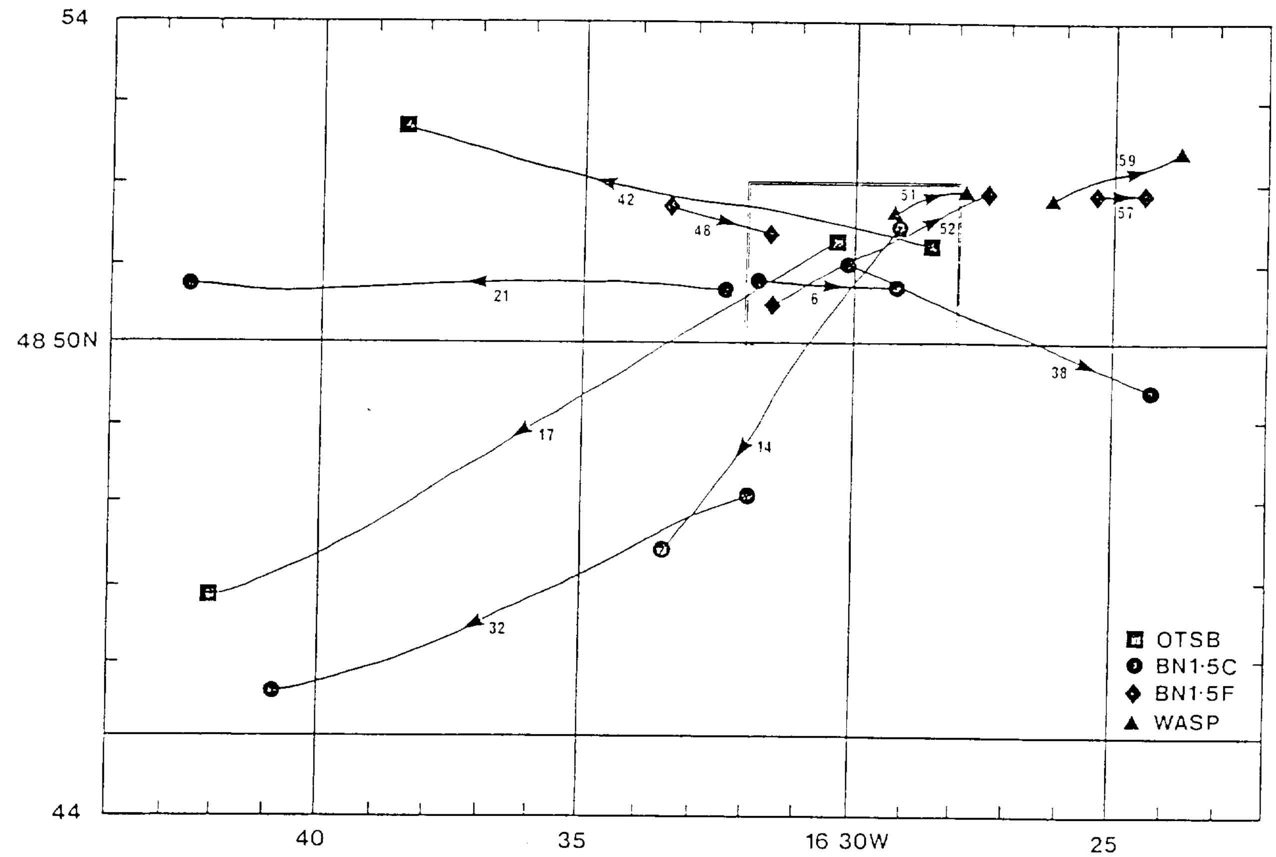

Figure 2. Station 52701. Tracks of towed gears. The box encompasses positions of vertically deployed gears (see Fig. 3)

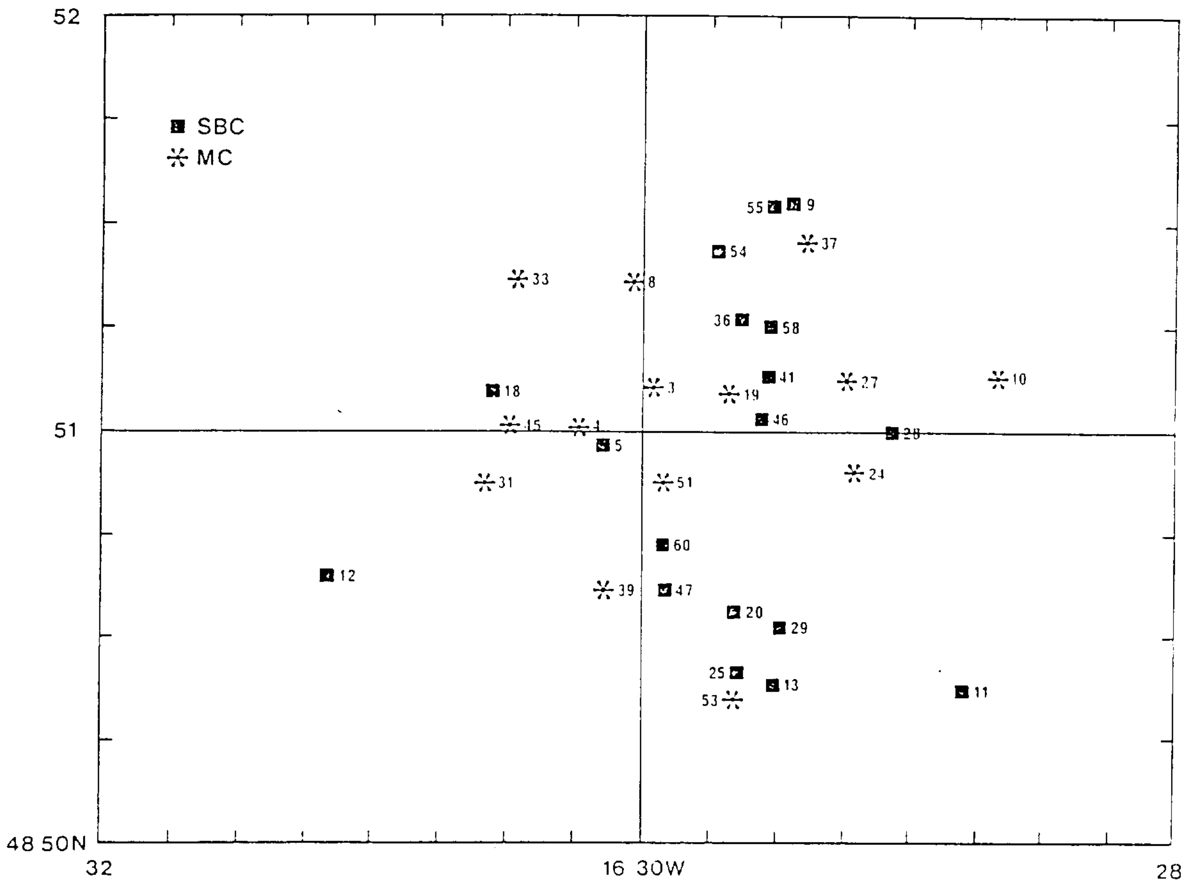

Figure 3. Positions of multiple corer and spade box corer deployments.